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Examination	Requested
Title of Invention	LIGHT EMITTING DIODE AND MANUFACTURING METHOD THEREOF

Abstract

Temperature and NH of 500~900℃ photoresist is formed on the front side except for electrode on the p-type epitaxial layer the electrode in which the process complicateds and which is included in the electrode metalization of the GaTi layer on n-type and p-type epitaxial layer the nonefficient problem is solved, and al layer ,Au layer is formed at the same time as the light emitting diode and manufacturing method thereof.3, N2It heat-treats in the middle one mood and n-type and P-contact are formed. In that way the light emitting diode in which the process is simple and the conductivity is improved can be manufactured.

Representative Drawing(s)

Fig. 3

Description

※ Brief Explanation of the Drawing(s)

Figures 1a through 1d are the processing sectional view showing the manufacturing process of the light emitting diode according to prior art

Figures 2a through 2d are the processing sectional view showing the manufacturing process of the light emitting diode according to the present invention

Figure 3 is a structure sectional diagram showing the light emitting diode according to the present invention.

* The description of reference numerals showing the main elements in drawings.

11: substrate 12: n-epitaxial layer.

13: active layer 14: p-type epitaxial layer.

15: gaTi layer 16: al layer.

17: au layer 18: photoresist.

※ Detail of the Invention

■ Purpose of the Invention

■ The Technical Field to which the Invention belongs and the Prior Art in that Field

The invention relates to the light emitting diode. And particularly, it is about the light emitting diode forming electrode regardless of the doping type and manufacturing method thereof.

If referring to the figure, the light emitting diode according to prior art and the attached manufacturing method thereof are explained, it hereinafter thes same like next.

Figures 1a through 1d are the processing sectional view showing the manufacturing process of the light emitting diode according to prior art.

The N-epitaxial layer (2) doping the n-type impurity on the sapphire substrate (1) is something/somebody grow up made as shown in the drawing 1a to the constant thickness. And the p-type epitaxial layer (4) which consecutively dopes the active layer (3) and p-type impurity on the N-epitaxial layer (2) is something/somebody grow up made to the constant thickness.

At this time, si is used as the n-type impurity and Mg is used as the p-type impurity. And n-type and p-type epitaxial layers (2,4) to GaN.

The active layer (3) and p-type epitaxial layer (4) are eliminated selectively to the photolithographical (photo1ithography) and etching process and the constant area of the N-epitaxial layer (2) is exposed as shown in the drawing 1b.

The first photoresist is spread in n-type and p-type epitaxial layer (2,4) front side and it patterns and the constant area of the N-epitaxial layer (2) is exposed as shown in the drawing 1c. And the Ti layer (5), the Al layer (6), and the Ti layer (5) and Au layer (7) are formed successively on the first photoresist front side including the N-epitaxial layer (2) exposing and the formed Ti layer (5), the Al layer (6), and the Ti layer (5) and Au layer (7) are eliminated and N type electrode is formed into the lift-off process on the first photoresist and the first photoresist.

The second photosensitive film is spread as shown in the drawing 1d in n-type and the p-type epitaxial layer (2,4) front side including N type electrode and it patterns and the constant area of the p-type epitaxial layer (4) is exposed. And the Ti layer (5), the Cr layer (8), and the Ti layer (5) and Au layer (7) are formed successively on the second photosensitive film front side including the p-type epitaxial layer (4) exposing and the formed

Ti layer (5), the Cr layer (8), and the Ti layer (5) and Au layer (7) are eliminated to the lift-off process on the second photosensitive film and the second photosensitive film and P-contact is formed.

It thes same like next if the structure of the light emitting diode formed in this way is explained.

It is composed of the N-epitaxial layer (2) formed as shown in the drawing 1d on the sapphire substrate (1), and the active layer (3) and N type electrode consisting of the Ti layer (5), the Al layer (6), and the Ti layer (5) it is formed in the constant area on the p-type epitaxial layer (4), and N-epitaxial layer (2) and au layer (7) formed in the constant area on the N-epitaxial layer (2), and P-contact consisting of the Ti layer (5), the Cr layer (8), and the Ti layer (5) it is formed in the constant area on the p-type epitaxial layer (4) and au layer (7).

▪ The Technical Challenges of the Invention

The light emitting diode according to prior art and manufacturing method thereof have the following problems:.

In the first, and the n-type in the electrode metalization, by compartmentalizing in the Au / Ti / Al / Ti, and p-type into the Au / Ti / Cr / Ti and forming the process complicateds and it is nonefficient.

In order to manufacture the light emitting diode in which the conductivity goods, in case of the high doping to being made but making the high doping the crack etc. are formed the dopant in the epitaxial layer and the yield of the light emitting diode is dropt the second.

An object of the present invention to provide the light emitting diode and the manufacturing method thereof in which electrode is formed into the thing for solving this kind of problem regardless of the doping type (Dopingtype) and simplifying the process.

It are another object of the present invention to provide the light emitting diode and the manufacturing method thereof in which the structure of electrode is formed in order to be high-doped in the epitaxial layer and the conductivity is improved.

▪ Structure & Operation of the Invention

There can be the feature it is included as in the light emitting diode according to the invention for achieving this kind of purpose and manufacturing method thereof, N type electrode and P-contact the GaTi layer, the Al layer, and the Au layer.

The other feature of the present invention at the same time forms N type electrode and P-contact.

After another characteristic of the present invention forms photoresist on the front side except for electrode on the p-type epitaxial layer, it at the same time heat-treats.

Another characteristic of the present invention is the temperature of 500~900℃ and NH.3, N2It heat-treats in the middle one mood.

It as described in detail thes same than the drawing attached the light emitting diode according to the present invention as described above and manufacturing method thereof like next.

Figures 2a through 2d are the processing sectional view showing the manufacturing process of the light emitting diode according to the present invention.

The N-epitaxial layer (12) doping the n-type impurity on the sapphire substrate (11) which it cleanly washes is something/somebody grow up made as shown in the drawing 2a to the constant thickness. And the p-type epitaxial layer (14) which consecutively dopes the active layer (13) and p-type impurity on the N-epitaxial layer (12) is something/somebody grow up made to the constant thickness.

At this time, n-type and p-type epitaxial layers (12,14) to GaN.

Subsequently, the active layer (13) and p-type epitaxial layer (14) are eliminated selectively to the photolithographical (photolithography) and etching process and the constant area of the N-epitaxial layer (12) is exposed as shown in the drawing 2b.

And after the GaTi layer (15), and the Al layer (16) and Au layer (17) are formed successively as shown in the drawing 2c on n-type and p-type epitaxial layers (12,14), it ***s the GaTi layer (15), and the Al layer (16) and the Au layer (17) is patterned and the first electrode is formed in the constant area of the N-epitaxial layer (12) and the second electrode is formed in the constant area of the p-type epitaxial layer (14).

At this time, the thickness of the GaTi layer (15) forms into 200 ~300 Å.

And the Al layer (16) between the Au layer (17) and the GaTi layer (15) the barrier role protecting sombody/something from the reaction of the Au layer (17) and GaTi layer (15).

Subsequently, the photoresist (18) is formed on n-type and the p-type epitaxial layer (12,14) front side including the first as shown in the drawing 2d, and second electrode and it patterns and the second electrode is exposed. And the front side including the second electrode exposing is heat-treated and the first electrode forms into n-type and the second electrode forms into p-type.

At this time, the thermal process is NH3In other words, n2It is included at a temperature of the mood and about 500~900℃.

In this way, the reason why the first, and the doping type of the second electrode pitch by heat-treating are as follows.

NH3In other words, n2In the mood, it unites with N and lower-part, and the GaTi layer (15) of the second electrode exposing make GaTiN.

The gaTi layer (15) formed in the interface of P-type epitaxial layer (14) is to GaTiN. In that way it protects sombody/something from to N be expanded to the GaTi layer (15) and come out from the GaN of the p-type epitaxial layer (14) and N are rather more expanded to the p-type epitaxial layer (14) and many hole carrier is formed.

Moreover, the first electrode is NH3In other words, n2It seems to be heat-treated in the standby state since nots exposing to the mood.

Therefore, by being expanded to the gaTi layer (15) formed in the interface of N is the N-epitaxial layer (12) in GaN of the N-epitaxial layer (12) and freeing from special favor person carrier (electron carrier) are formed in the N-epitaxial layer (12).

And the light emitting diode forming electrode regardless of the doping type the photoresist (18) remaining as the next process is eliminated is completed.

Figure 3 is a structure sectional diagram showing the light emitting diode according to the present invention.

It is composed of the N-epitaxial layer (12) formed as shown in fig. 3 on the sapphire substrate (11), and the active layer (13) and N type electrode consisting of the GaTi layer (15), and the Al layer (16) it is formed in the constant area on the p-type epitaxial layer (14), and N-epitaxial layer (12) and au layer (17) formed in the constant area on the N-epitaxial layer (12), and P-contact consisting of the GaTi layer (15), and the Al layer (16) it is formed in the constant area on the p-type epitaxial layer (14) and au layer (17).

◙ Effects of the Invention

As to the light emitting diode according to the present invention and manufacturing method thereof, the effect as follows has.

By at the same time forming electrode regardless of the doping type the process can be simplified and efficiency can be enhanced the first.

The second, and NH.3In other words, n2By heat-treating in the mood the doping type pitches and it is high-doped in the epitaxial layer at the same time the light emitting diode in which the conductivity is improved can be manufactured.

Scope of Claims

Claim 1 :

The light emitting DIODE which characterizes to be included including the step of heat-treating the front side including first, the step of forming photoresist on the second epitaxial layer front side and patterning and exposing the second electrode, and second electrode including first, the step of forming photoresist on the second epitaxial layer front side and patterning and exposing the second electrode, and second electrode and eliminating photoresist.

Claim 2 :

The light emitting DIODE which the first, and the second epitaxial layer characterize as to the first claim to form into GaN.

Claim 3 :

The light emitting DIODE which characterizes that as to as to the first metal layer, the second metal layer, the metal three layer forms as to the first claim into GaTi into Al into Au.

Claim 4 :

The light emitting DIODE which the thickness of the first metal layer characterizes as to the first claim to form into 200~300 Å.

Claim 5 :

The light emitting DIODE which the thermal process characterizes as to the first claim to be included of the temperature of 500~900℃.

Claim 6 :

The thermal process as to the first claim, is NH.3, N2The light emitting DIODE which characterizes to be included in the middle one mood.

Claim 7 :

The light emitting diode which characterizes to be composed including the second electrode consisting of first electrode, and the GaTi layer, the Al layer, and the Au layer it is formed in the constant area of the second

epitaxial layer consisting of the first epitaxial layer formed in the top of the substrate, the active layer and the second epitaxial layer, and the GaTi layer, the Al layer, and the Au layer it is formed in the constant area of the first epitaxial layer. The active layer and the second epitaxial layer is laminated in the constant area of the first epitaxial layer and is formed.

Claim 8 :

The light emitting diode which the first, and the second epitaxial layer characterize as to claim 7 to be formed into GaN.

Drawings

Fig. 1a

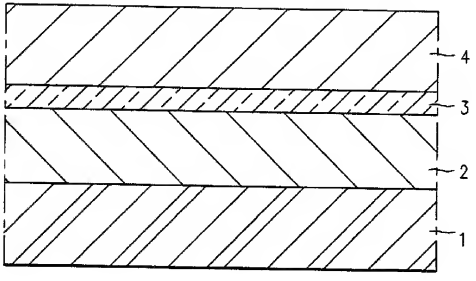

Fig. 1b

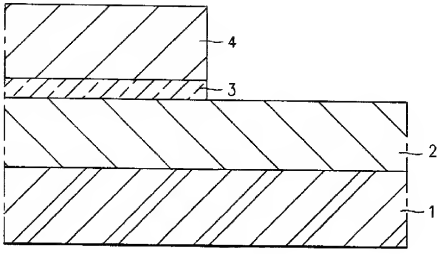

Fig. 1c

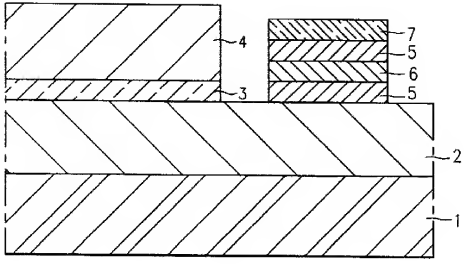

Fig. 1d

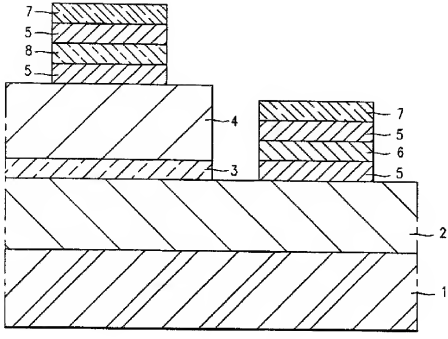

Fig. 2a

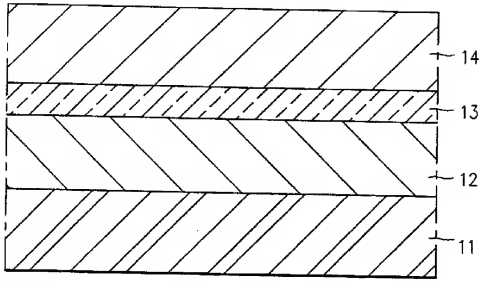

Fig. 2b

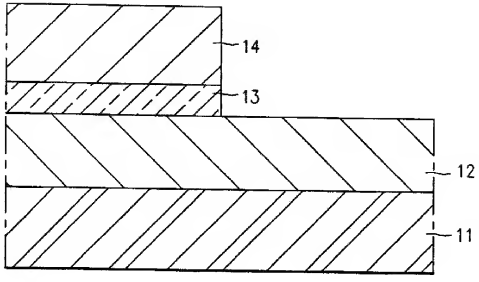

Fig. 2c

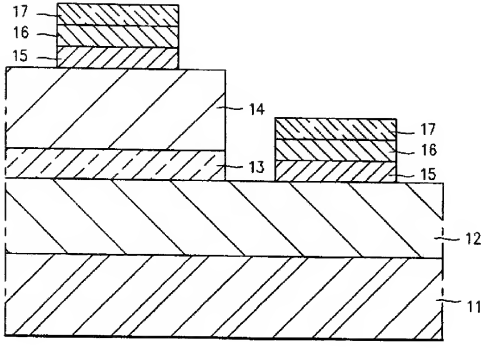

Fig. 2d

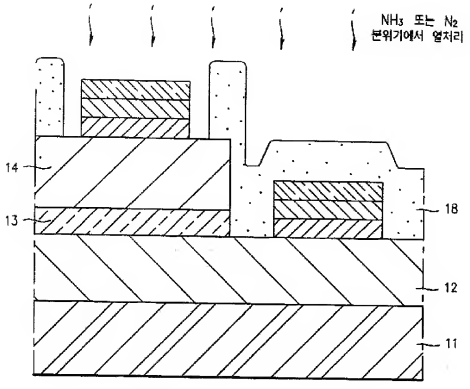

Fig. 3